



INDIANA OFFICE OF ENERGY AND DEFENSE DEVELOPMENT



Future Energy Alternatives Business Plan

November 2007

FUTURE ENERGY ALTERNATIVES HIGH LEVEL BUSINESS PLAN

Future Energy Alternatives addresses the development of new approaches to providing energy and power for military stations, both inside and outside the USA, homeland security, and civilian use through Fuel Production, Energy Conversion, Storage Systems, and Energy Management. The large potential for sales derived from two of the historic Indiana industries - farming and automotive/aerospace power systems - justifies an investment in meeting the two major care-about of the military, which include independence from foreign oil and conversion of energy based on mission location and conditions.

DETAILED DESCRIPTION:

This focus area covers the multiple ways that power is delivered for use by humans and machines. It consists of the following segments:

- Fuel Production, such as coal, synfuel and bio fuels (ethanol, bio-diesel)
- Energy Conversion, such as Internal combustion (gas engines, diesels, and gas turbines), Nuclear fusion/fission, solar, wind, hydro and geothermal
- Storage Systems, such as batteries, fuel cells, and ultra capacitors
- Precision Energy Management to delivery better quality electricity efficiently across multiple energy converters in multiple output profiles

Future fuels for the military must consider: a common fuel to reduce storage and logistics complexity (common fuel), availability at points of deployment, and sustainability of source of supply.

Energy conversion, storage, and precision energy management systems as packaged in integrated power systems will range in size from military base to forward base to enclave to personal to device. Key user requirements include: conservation/efficiency, emission control, portability (size, weight), life, ease of installation at point of deployment and maintainability. Functions provided include Studies and Consulting, Research and Development, Component Manufacturing, Systems Manufacturing and Integration, Installation and Construction, and Service and Support.

Knowledge assets needed in this focus area are: Analytical Chemistry, Nanotechnology, Composite Materials, Fisher Tropsch, Clean Coal Technologies, Sequestration, Fuel Cells, Nuclear Science, Wind turbines, Solar Cells, Power Electronics, Analytic Chemistry, and Plant Biology /Agricultural Sciences.

IMPORTANCE FOR INDIANA TO FOCUS AND COLLABORATE ON FUTURE ENERGY ALTERNATIVES

In the area of fuels, there is much wealth to be gained from the natural resources owned by Indiana's land owners from the biomass being farmed to the vast coal deposits of Southern Indiana. The state has already recognized this area as a strategic one to move itself towards self sufficiency and the addition of a military market will further justify investment in this area. Additionally, the competency at Purdue in Ethanol production and the Fischer-Tropsch method of converting coal to liquid synthetic fuel and lubricant are highly exportable ones.

In the area of energy conversion, major Indiana corporations such as Cummins (diesel engines) and Rolls Royce (gas turbines, jet engines) and other research companies have R&D resources and years of engineering experience that can be applied to new fuels in order to sustain their future success in the coming era where the world is to be weaned off of oil and gasoline. Other companies in the state are focusing on both enhancing traditional engine

types and exploiting new means of energy conversion. Crane has a strong storage systems competency. There are other state companies that provide component systems that enable engines and other energy converters, harness power from transportation transmission systems, vehicle braking systems, AC/DC conversion, and fuel control systems.

The emerging and heightened needs for greater energy efficiency, reduced environmental impact, and precision power (required by the new manufacturing and information technology industries) are creating a new set of hard problems. These problems range from how to adapt existing engines to the new fuels to how to create competitive power (propulsion, electricity) from the new energy sources, and how to deliver power multiple power profiles (voltage, wattage, AC cycles) from multiple power sources simultaneously in one management system.

Because of their complexity and the many viable alternatives for their solution, the solution to these hard problems will require multiple organizations to work together. Government vehicles for getting the funding to answer these problems will require the responders to be teams working in collaboration.

Table 33 below indicates the existence of Future Energy Alternatives assets in Indiana. They are spread throughout the state, starting with a State-supported Biofuels Plants plant program (twelve new Ethanol plants and four new biodiesel plants built that were scattered throughout the state in 2006.) Also, in Columbus and Indianapolis there are large companies' involved in energy conversion systems, storage systems competency is seen at Crane, and synthetic fuel activity state with strong R&D is seen in alternative energy at Purdue, and energy Management efforts are evidenced in Anderson and West Lafayette.

Table 1

INDIANA ASSETS

<u>University</u>		<u>Large Companies</u>	<u>Small Companies</u>	
PU Center for Coal Technology Research	ND/Crane Center for Advanced Fuel Cell Technology	Rolls Royce	NuVant Systems	Swift Enterprises
PU Energy Center	ND Energy Center	Cummins	Trexco	Dwyer Instruments
PU International Rectifier Power Electronics Lab	ND/Crane Center for Advanced Fuel Cell Technology	Delphi Electronics and Safety	PowerSys	I Power Energy Systems
PU Hybrid Vehicle Lab	IU, PU, and ND tops in Analytical chemistry	Honeywell (fuel controls, brakes)	Altair Nanotechnologies	Water Furnace
PU Hydrogen Storage and Fuel Cells Lab	IU, PU, and ND tops in Nuclear Power	<u>Other</u>		
PU Agriculture School	Valparaiso: solar energy and nuclear radiation remediation research	State-supported Biofuels Plants	Electricore Consortium branch	Indiana Cellulosic Fuel Production Challenge
IUPUI Lugar Center for Renewable Energy	Ball State Center for Energy Research	BioTown	Huge space for Carbon Sequestration	Indiana Innovation Network
IUPUI Advanced Energy Research Lab	Rose-Hulman projects in Alternative Energy			
<u>Crane</u>				
Battery Competency	Energy & Power System Competency			

There is a foundation for immediate action, as the following initiatives have been identified by the Indianans already involved in this focus area:

- MicroGrid – a Precision Power Management test bed (1.5 MW output with Control System, Electrical Power Shaping, and Fuel Control components)
- Bio Diesel/Bio Gas Competency Center and Test Center
- J8 Fuel Initiative
- Lithium Ion Battery Competency Center
- Capability to quickly deploy a small bio fuel plant to a crisis spot

There is also a crosscut of this focus group with the Transportation Systems group.

PROPOSED TEAM ACTION PLAN

IN YEAR ONE:

1. A conference on the subject of DOD/DHS Energy Opportunities with 100 people
2. A team to bring people together and to mentor on DOD procedures like SBIR
3. Success on one or two specific opportunities, e.g., SBIRs/STTRs using Crane's grant priorities

To perform the following activities to meet this plan, entities outside the team must be exposed to a state marketing plan and educational activities on how to do business with the government. The team expects that it will participate in the planning and support for these activities.

IN YEAR TWO:

1. Obtain \$20M in funding for grants, contracts or other awards
2. Create a Industry group like IAAMA (Indiana Advanced Aerospace Manufacturing Alliance)
3. Four Tech Transfer projects from Universities underway
4. Researchers from academia working as leads in companies working in summers or over a year
5. Testing of bio-diesel, jet fuel *beyond a laboratory*.
6. A university researcher to take a difficult industry problem and find relevant funding

Entities outside this team must perform continual enhancement of a database for locating potential partners and maintaining a situation alert system to meet this plan. The team expects that it will participate in the planning and support for these activities.

RECOMMENDED STAKEHOLDER ACTIONS

This focus area will depend on specific actions on the part of stakeholders within the state.¹

PUBLIC/PRIVATE DEFENSE ASSETS CONSORTIUM

- Facilitate better collaboration between commercial companies, between universities, and Federal and State legislators to build relationships, catalyze efforts to address specific initiatives/contract opportunities, and discuss issues.
- Organize national meeting with government program managers and chief technology officers to learn about capabilities needed by DOD and Homeland Security and to familiarize them with Indiana assets.

¹ Some of these actions have been collected across focus areas and will be presented as composite strategic recommendations later in this report. Where they are unique to Future Energy Alternatives, they have more detail.

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- Provide information on potential opportunities.
 - Create and manage a program for marketing Indiana as a defense technologies state.
 - Identify a champion for this focus area to help it moves forward.
 - Reestablish the local chapter of the Technology Transfer Society.
 - Inform potential state providers what the military wants.

STATE GOVERNMENT

- Provide education for a small company new to Defense procedures and terms. DOD contracts are requiring a larger portion of works to be done by Small and/or Minority owned business.
- Give first-time proposers SBIR proposal preparation assistance.
- Put the 21st Century Fund SBIR matching program on a sustainable basis.
- Institute a quick grant proposal process.
- Grow the statewide database of available state assets. Because of the breadth of this focus area a mapping based on the above four segments, markets, and the idea to product lifecycle should be incorporated.
- Push Energy Conservation in the state.
- Provide champions that are involved with this focus area.
- Get Leadership's commitment all the way to the Governor's office.
- Enhance the Buy Indiana program. For example, when building a manufacturing plant, buy an Indiana-developed and built co-generator.

INDUSTRY

- Staff an SBIR coordinator with each company.
- Participate in technology cross licensing.
- Inform the Consortium of opportunities in developmental research.
- Develop, with universities, a "Technology R&D Vertical Integration" program where university researchers work on their technology in the university's research labs, then during sabbatical work in the commercial sector to transition their technology to commercialization.
- Develop a program and strategies to involve engineering students who are foreign nationals. A hallmark of having a world class Electronics program is that it attracts the brightest from around the world. It is important for a company to attract these students as permanent hires and make them productive on DOD work as soon as possible.
- Encourage employees to work on university project (and universities to include company people in their projects. (See academia's need to protect company IP below).
- Effort by large companies to find more local small companies to work as subcontractors.
- Outsource people from large companies to be executives and business development management in startups and to sit on boards.
- Liberate orphan technology.

CRANE

- Be proactive in stating requirements.
- Be proactive in technology scan.
- Make the current yearly Crane "Show and Tell".

ACADEMIA

- Develop, with the commercial sector, a “Technology R&D Vertical Integration” program where university researchers work on their technology in the university’s research labs, then during sabbatical work in the commercial sector to transition their technology to commercialization.
- Dramatically expand the Systems Engineering program across the state.
- Improve the technology transfer process to release more technology for commercialization by commercial state assets without endangering the latter’s competitiveness.
- Open up the availability of information about what’s going on in the Institution to commercial companies, instead of merely relying on the PR pieces.
- Hold scientist to scientist exchanges within institution and among institutions.
- Improve a company’s access to university resources.
- Improve the availability of intermediate level engineers.
- Educate the supporting technicians in this focus area.

IMPLEMENTATION PLAN

ORGANIZATION AND SUSTAINABILITY

The opportunities from Defense and Homeland Security group in this focus area are felt to be pretty dynamic and spontaneous. An agile organization built around small teams of stakeholders is expected to be the best way to organize rather than invest in a standing infrastructure.

The nature of this focus area is capital intensive. For example, a clean coal technology plant will average over \$1 billion to build, while ethanol plants will cost over a \$100 million each. Power systems take a long time to develop and prove out, thus requiring much up front investment until there is a revenue stream. While SBIRs and federal grants can help in creating new capabilities, private funding sources need to be found for sustainability.

For ultimate success, this focus area must have some initial wins to show that collaboration is effective and to attract other companies, especially SMEs not yet doing business with the government, into the effort of gaining \$ from these customers. This means that the organizational structure has to avoid the heavy-handed processes of the past and proceed in a self-organizing network manner.

METRICS

The following parameters are recommended as a source for three to seven vital performance measures:

- Revenue from military and homeland security derived by collaborative efforts in this focus area
- Investments made to secure military business
- Jobs created or retained
- Research \$ obtained
- Student involvement
- # of SBIRs that go to Phase 3

SUMMARY

The Future Energy Alternatives focus area already has momentum for the fuel production segment from the state’s strategic plan, and collaborative activity in this area is underway. The other segments in this focus area can be converged to concentrate on power systems in a variety of configurations that will fit a standard architecture and unleash the economics of mass production and commercial off the shelf (COTS) products for military and homeland security. If it is pursued on pursued from the ground floor, this capability concentration can give Indiana

companies a major source of revenue over a long period of time. To seize these opportunities, the Future Energy Alternatives team must achieve the following objectives:

1. Access to a central “consortium” that can manage marketing, the high level customer relationships, centralized infrastructure, a reputation for success, high level state relationships, and growth/renewal
2. An active, on-going program to recruit, involve, and assist SMEs in obtaining Defense Assets business
3. An improved process for getting IP out of Indiana Universities so that it can be commercialized
4. A partnership of all the players with a strong teaming attitude and knowledgeable leaders acting as catalysts not overlords
5. Attracting, retaining, and upgrading knowledge and tradecraft relating to those fuel production and power systems that match Indiana’s assets